

GEOMETRY – FIELDS FOREVER

You have 60 minutes to complete the following 30 multiple-choice questions. Choices A through D are answer choices for every problem. Choice E stands for “none of these answers,” or NOTA. Scoring is as follows: 5 points for a correct answer, 1 point if left unanswered, and 0 points for an incorrect response. Units are assumed. Diagrams not to scale.

1. Enrie and Michael are trying to plan their trip throughout the heart and soul of America: the Breadbasket! They decide to visit Nebraska, Idaho, and Kansas, in that order. Assume the trip begins in Tallahassee. Kansas is 1500 miles north and 1500 miles west of Tallahassee, Nebraska is 500 miles north of Kansas, and Idaho is 750 miles north and 1000 miles west of Nebraska. If they take the shortest route possible between destinations, what is the total distance travelled during their trip?

- A) $250\sqrt{221}$ miles B) $500 + 1500\sqrt{2} + 250\sqrt{13}$ miles
C) $3750 + 250\sqrt{41}$ miles D) 5250 miles E) NOTA

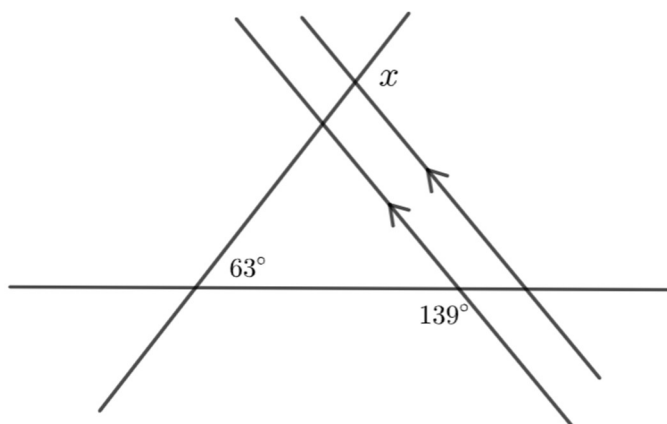
2. In Nebraska, Enrie and Michael find some weirdly shaped corn! The corn is shaped like an isosceles triangle with side lengths of 4, 7, and 7 inches. What is the altitude of the corn that is perpendicular to its base?

- A) $3\sqrt{5}$ inches B) 7 inches C) $\sqrt{65}$ inches D) $\sqrt{113}/2$ inches E) NOTA

3. Once the two arrive in Idaho, Michael finds a potato field surrounded by a fence. He calculates the length of the fence to be 7927 meters, exactly. Enrie points out that the shape formed by the fence maximizes the enclosed area of the field. How many sides does the shape formed by the fence have, assuming the fence posts are negligible in size?

- A) 3 B) 4 C) 5 D) 6 E) NOTA

4. They finally reach their final destination, Kansas! In Kansas, there are fields and fields of wheat! Using the stalks of wheat, Michael creates the shape shown below. What is the measure of angle x ?



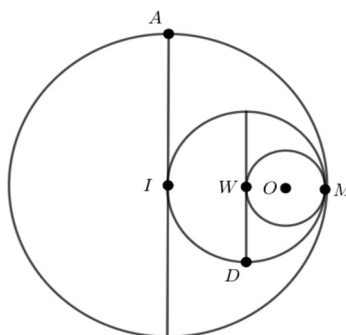
- A) 63° B) 76° C) 104° D) 139° E) NOTA

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5. Most of the Midwest was initially explored by Rene-Robert Cavelier, Sieur de La Salle in the 1680s. How many diagonals does a regular n -sided polygon have, given that n is the number of distinct letters in Rene-Robert Cavelier, Sieur de La Salle's name?

- A) 15 B) 32 C) 77 D) 464 E) NOTA

6. Before they were captured into Area 51, an alien UFO drew a pattern in Akhil's beet farm. The pattern was drawn as shown in the diagram below. Circle W was inscribed inside a semicircle of circle I. Circle O was inscribed inside a semicircle of circle W. Assume that the diameters of circles I and W are parallel. If the diameter of circle I is 48, what is the area of triangle DOA, in square units?



- A) $90\sqrt{5}$ B) 144 C) 180 D) 288 E) NOTA

7. One of the best things about the Midwest are the road attractions! For example, the world's largest ball of twine in Kansas, the world's biggest basket in Ohio, and the world's biggest ball of paint in Indiana. The longitudes and latitudes of these attractions are (39, -98), (40, -82), and (42, -92), respectively. What is the area of the triangle that's created by these three coordinates?

- A) 10.5 B) 21 C) 42 D) $6\sqrt{130}$ E) NOTA

8. Venkat decides to be a sweet potato farmer in Oklahoma. He owns a pet duckling named Vera who eats everything but sweet potatoes. Because of this, he wants to build a house made entirely of sweet potatoes for him and his pet so they can live happily together. However, Vera is very picky, and only likes houses in the shape of a hemisphere. The circumference of their house is 12π ft. Calculate the height of Vera in inches if her head perfectly touches the ceiling 4 ft away from the center of the house.

- A) $2\sqrt{5}$ B) $2\sqrt{13}$ C) $24\sqrt{5}$ D) $24\sqrt{13}$ E) NOTA

9. Due to the massive production of wheat in the Breadbasket, silos are crucial for storage. One particular silo is shaped like a cylinder with a hemisphere on top. The radii of both volumes are 6 meters. The volume of the entire silo is 720π m³. There's a leak at the bottom that drains the wheat at a rate of 8π m³/minute. The silo starts leaking at 12:00 PM. Assuming the silo was full to start with, what time will it be when the height of the wheat inside the silo is 4 meters?

- A) 12:18 PM B) 1:12 PM C) 1:17 PM D) 1:30 PM E) NOTA

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10. Being brothers, Aaron and Alex have a lot of similarities. For instance, both love probability and corn! Because of this, they decide to play a variation of hide and seek in a small Nebraska cornfield which is 50 ft x 50 ft. Unbeknownst to them part of the field has been sprayed with as a test for a new chemical. If the sprayed space is 30 ft x 20 ft what is the probability that one of them is hiding in the contaminated area?

- A) $\frac{6}{25}$ B) $\frac{2}{5}$ C) $\frac{3}{5}$ D) $\frac{51}{100}$ E) NOTA

11. The world's largest ketchup bottle can be found in Collinsville, Illinois, and stands at a whopping 140 ft! It stands next to a 10 ft. building. If a string is tied from the top of each figure to the bottom of the other figure, how high above the ground is the intersection of the two strings?

- A) 8'10" B) 9'4" C) 75' D) Not enough info E) NOTA

12. Wesley dreams big and wants to have his own barn when he grows up! After doing intense research on the best type of barn, he found the perfect model for his needs! His dream barn is shaped as a trapezoidal prism, where the trapezoidal faces have bases of lengths 20 ft and 30 ft. Given that barn has a length of 60 ft and a height of 12 ft, calculate the surface area of the entire barn.

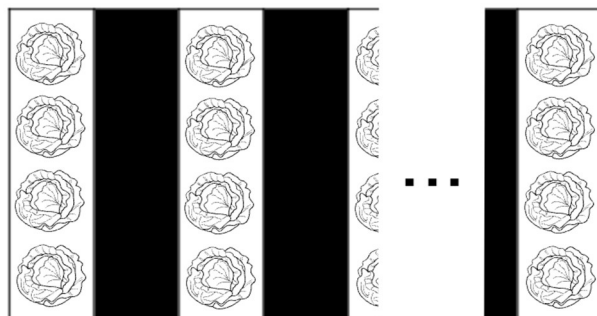
- A) 3360 ft² B) 5040 ft² C) 5100 ft² D) 5160 ft² E) NOTA

13. The Missouri river runs throughout the entire Midwest, which is perfect for irrigation for Arib's farm. His irrigation system is unusual, however, because it requires the workforce of both of his brothers, Zuhair and Ammar. Ammar is located at point (5, -3), and travels to the Missouri river located on $x = -5$ to meet Zuhair and collect the water needed for their farm, located at point (13, 18). If Ammar successfully delivers the water to Arib's farm in the shortest distance possible, what is the ordinate of Zuhair's location on the river?

- A) 0 B) 4.5 C) 7.5 D) 9 E) NOTA

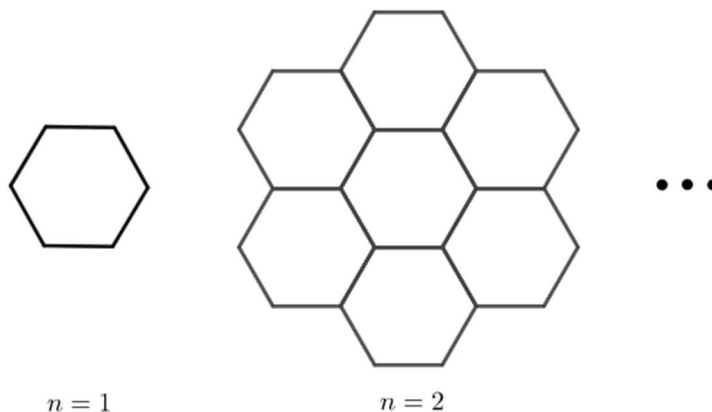
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14. Jessica is growing heads of lettuce because she loves vegetables! Her crop field is represented by the figure below, with n white rows representing the row of lettuce and $n-1$ black rows representing unoccupied soil. Each row of lettuce is 1 ft wide, while each unoccupied row is 1.5 ft wide. If each row is 4 ft long and each row of lettuce contains 4 heads of lettuce, what is the area of the entire field if it contains 92 heads of lettuce?



- A) 224 ft² B) 226 ft² C) 230 ft² D) 324 ft² E) NOTA

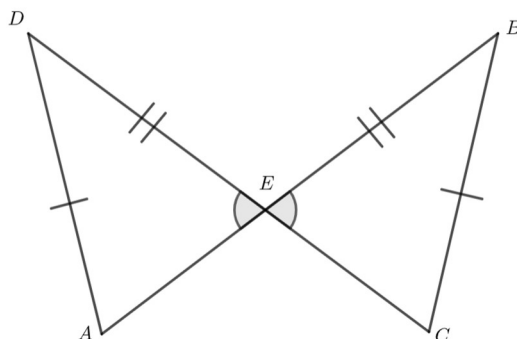
15. Freed loves puzzles and loves North Dakota. Given that North Dakota is the top honey producing state in the country, it's no surprise that Freed also loves honeycombs – nature's own puzzle. The number n is the number of layers of hexagons in a certain honeycomb pattern, such that every layer is the previous layer with each edge covered by an edge of a new rectangle. The first two figures are shown in the figure below. How many vertices are shared by 3 hexagons in a honeycomb where $n = 10$?



- A) 486 B) 540 C) 600 D) 726 E) NOTA

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16. Jackson's favorite event of the year is the annual Sunbelt Agricultural Expo! In preparation for the Expo, Jackson decides to sport a quirky but fitting bowtie. The shape of the unusual article is shown below as figure DAECB. If the measure of angle DEB is 120 degrees and the measure of angle DEA is 75 degrees, what must be the measure of angle BEC?



- A) 45 B) 55 C) 60 D) 75 E) NOTA

17. Jessie the Cow is one of Farmer Parul's most prized cattle. Because of this, Farmer Parul spoiled Jessie the Cow with her own bed. However, her bed is an unusual bed, as it's shaped as an obtuse isosceles triangle! The bed is modeled by the triangle BED. Given that angle BED is 120 degrees, angle EDB is 30 degrees, and the height of the triangle is 17, find the perimeter of triangle DEB.

- A) $51 + 17\sqrt{2}$ B) $51 + 17\sqrt{3}$ C) $68 + 34\sqrt{2}$ D) $68 + 34\sqrt{3}$ E) NOTA

18. Steve lives in a blocky world, but is getting tired of the same 4-sided shapes. In the real world, however, he likes to spice things up and prefers anything but four sided figures! Due to this, he creates his potato farm in the shape of a dodecagon. His potato farm has an apothem of length 8 meters and an area of 912 meters². What is the area of an equilateral triangle with the same side length as Steve's potato farm?

- A) 57 meters² B) 76 meters² C) $90.25\sqrt{\frac{3}{4}}$ meters²
D) $\frac{361\sqrt{3}}{4}$ meters² E) NOTA

19. After a long day of mining diamonds on her computer, Ting decides to get a breath of fresh air and explore Steve's potato farm. If Ting finds a potato, she will get very excited and leg dab. Which of the following statements must be true?

- A) If Ting leg dabs, she found a potato
B) If Ting does not leg dab, then she did not find a potato.
C) If Ting does not find a potato, then she will not leg dab.
D) If Ting does not find a leg dab, she will kick a potato.
E) NOTA

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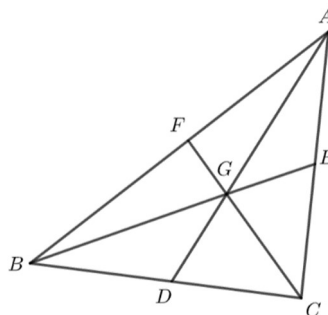
20. James wants to plant some wheat, but only a part of the plot is fertile enough for her to grow her wheat. If this part of the soil is shaped like a triangle VEN, what is the maximum possible length of VN subtracted from the minimum length of VN? VE equals $\frac{2}{3}$, and EN equals $\frac{38}{6}$.

- A) $-\frac{4}{3}$ B) $-\frac{3}{4}$ C) $\frac{3}{4}$ D) $\frac{4}{3}$ E) NOTA

21. As he walks along her plot to see if she can plant wheat anywhere else, he finds another triangular area! He measures the perimeter to have lengths 14, 16, and 18 feet. What is the area of this scalene triangle?

- A) $\frac{16\sqrt{3}}{4}$ B) 48 C) $48\sqrt{5}$ D) 112 E) NOTA

22. The aliens from question 6 were freed from Area 51! In order to conceal their identity, the aliens stopped drawing crop circles, and started drawing crop triangles with their medians, as shown in the figure at the right. If the area of triangle ABC is 36, what is the value equivalent to the area of ABE + AGF - BCE + 2020?



- A) 2020 B) 2026 C) 2038 D) cannot be determined E) NOTA

23. Jason is visiting Mount Rushmore with his friends in South Dakota. He notices that Thomas Jefferson has a stellar nose that resembles a pyramid and thinks of a math problem. If a right square pyramid has a base with an area of 16 inches and height of 24 inches and cut parallel to the base, it leaves a frustum along with a smaller pyramid. If the base of the smaller pyramid has an area of 4 inches², what is the volume of the frustum? (All answers are in inches³)

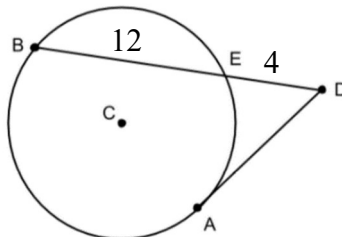
- A) 16 B) 64 C) 112 D) 128 E) NOTA

24. Brandon correctly answers Jason's math problem and decides to come up with one for Jason to solve. "What is the area of the vertical cross section through the middle of the frustum from the previous question?" he asks. If Jason correctly stated the answer, what did he say? (All answers are in inches²)

- A) 12 B) 24 C) 36 D) 48 E) NOTA

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25. David is working hard under the hot, sweltering Kansas sun and retreats to the pond for a water break. While he's getting hydrated, David is distracted by the most gorgeous duck he's ever seen. Scrambling to capture the duck's magnificent beauty for all of eternity, he comes up with a sketch represented by the diagram below. What is the length of AD if DE is 4, and EB is 12?

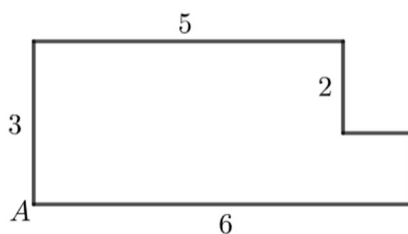


- A) 4 B) $3\sqrt{3}$ C) 6 D) 8 E) NOTA

26. Chansi the herd dog runs around oddly shaped barn. What is the sum of the interior angles of the building if it is a regular 24 sided n-gon?

- A) 360° B) 1680° C) 3960° D) 4200° E) NOTA

27. Chansi helps her owner determine all the space that is within 8 foot of the outside corner of the barn she is tied at point A and the length of her rope is 8 feet, what is the total area that can be roamed by her if she is tied to point A to a barn shaped like the diagram below?



- A) 8π B) 8.75π C) 29.25π D) 55.5π E) NOTA

28. What is the height of right circular cone that has a base of area 120 meters and a volume of 216,000 m³?

- A) 540 m B) 1800 m C) 5400 m D) 16200 m E) NOTA

29. What is the maximum number of intersections that can be made minus the minimum number of intersections that can be made with 12 non-parallel lines?

- A) 65 B) 66 C) 130 D) 132 E) NOTA

30. Vishal, James, and Yusuf are equally sharing an apple pie. However, Brandon shows up, so they each give Brandon a part of their share of pie such that all four of them have equal amount of pie. What is the length of the arc each of Brandon's three slices in terms of r, the radius of the pie?

- A) $\pi * r/12$ B) $\pi * r/6$ C) $2\pi * r/3$ D) $\pi * r/2$ E) NOTA